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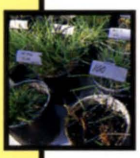


DEPARTMENTS

Gary Neuenswander

A Publication of the Utah Agricultural Experiment Station at Utah State University.
Volume 58 Number 2

UTAH SCIENCE

COVER STORY

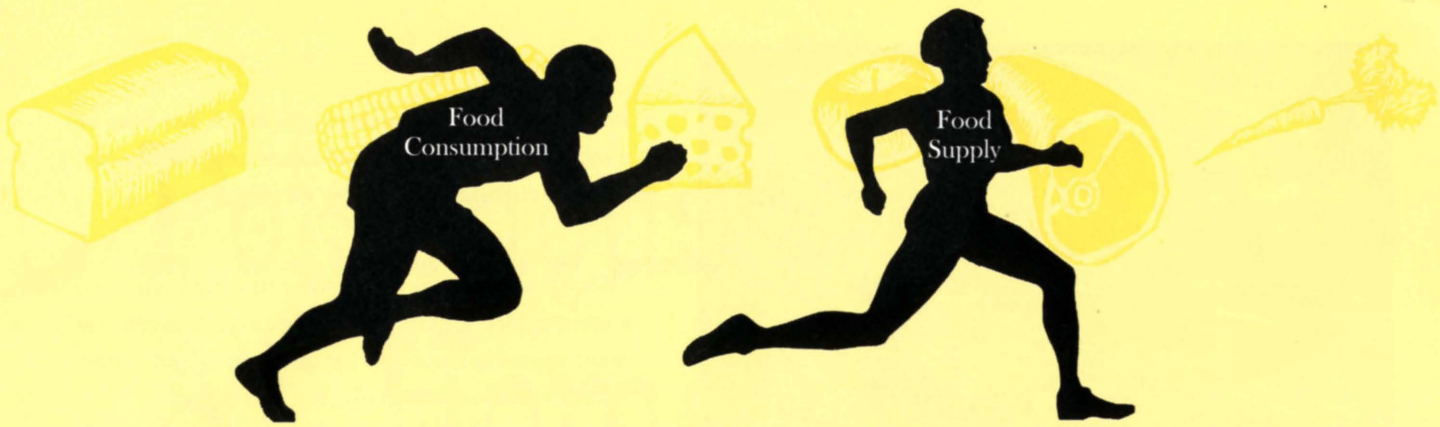
Food for Thought

You won't see any signs of it as you walk down the wide, well-stocked aisles of your U.S. supermarket, but the world's people are consuming more food than they produce.

While that is a fact most American shoppers don't tend to ponder, it is always on the minds of agricultural researchers. Not that scientists are predicting imminent famine in North America. They're just aware that there is a lot more to filling the pantry than looking in the newspaper for the week's best grocery buys.

"Few people realize how fragile our food supply is," says R. Dean Plowman, a former U.S. Undersecretary of Agriculture and Smithfield, Utah, native. "We've managed to stay ahead in this race, but that's the result of purposeful and careful research. There are some pretty formidable forces out there working against us."

Scientific researchers have created their own formidable force. A sizeable portion of it is embodied in the cooperative operating agreements among federal and state agricultural scientists, specifically between the USDA's Agricultural Research Service (ARS) and state agricultural experiment stations around the country.



The ARS has roughly 2,000 scientists and about 6,000 employees. Research is coordinated from eight regional sites across the country. Utah is part of the Northern Plains area.

In Utah, the ARS and the Utah Agricultural Experiment Station (UAES) work hand-in-hand to look out for possible threats to the food supply and to make sure an answer is available before the constantly mutating pests present a new problem.

For example, new varieties of grains are always in development in an effort to outrun the forms of smut disease that are naturally finding ways to overcome and destroy them. Reality dictates that what is resistant today won't be resistant tomorrow; pests survive to become the parents of a new strain of blight or bore or nuisance.

The ARS has three laboratories on the USU campus. The Forage and Range Research Laboratory, with administrative offices at the intersection of 700 North and 1100 East, uses UAES farms to help develop range and pasture plants and grasses, legumes and forbs for upgrading private and public lands in the western United States. (See story on page 14)

The ARS Poisonous Plant Research Laboratory, at 1400 North and 1200 East, helps farmers and ranchers reduce exposure of livestock to fatal and debilitating toxins found in some rangeland plants. (See story on page 5)

The ARS Bee Biology Lab, located at about 1500 North and 800 East, monitors native North American bees and has identified several different bees, including one native to Utah, that can help make up for the shortage in honeybees (See story on page 18.)

Roughly 95 percent of all federal agricultural research is done in conjunction with agricultural research centers located at land grant universities.

"A very small amount of federal research is conducted independently," says Jerry Chatterton, Research Leader at the Forage and Range Research Unit based at USU. "Virtually none of the work could be done without this partnership. The Experiment Station provides most of the land we use for our research."

UAES Director Paul Rasmussen says the association is a benefit not just to USU but to Utahns. "The ARS scientists on our campus provide additional expertise, resources and teamwork to address the myriad critical agricultural needs we're trying to address through research and education."

He says sharing facilities and resources with the ARS makes the public's investment in agricultural research "a real bargain. In fact, a safe and secure food, feed and fiber supply in the future will depend on such a productive, working partnership."

Some of the foes working to slow that supply nowadays include: the same blight that caused the Irish potato famine, a persistent mite infecting honeybees, the rate of improvement of hybrid plants to respond better to fertilizers is slowing, topsoil and actual acreage used for producing crops is eroding, less than 2 percent of the population lives on a farm,

ment in it and none of it is sitting idle. That way we're not duplicating equipment and getting the most out of tax dollars we use."

The story today is that poisonous plants cost livestock producers in the western United States about $234 million annually. Losses in Utah are estimated to be roughly $3 million. Poisonous plants, when eaten at certain times of the year or at too fast a rate, can be fatal or seriously debilitating to animals.

Locoweeds with details of flower and fruit. A-C, purple loco. D-F, blue loco.

They can initiate chronic illness that can last for months or, as in illnesses caused by locoweed, can last the animal's lifetime.

"I just had to tell this little kid from Wyoming whose horse had gotten into locoweed to just get a new horse," James says. "'Keep the sick one and pet it,' I told her, 'but you'll have to get another one to ride.' So we're not just talking economic loss here."

One of the main difficulties in dealing with poisonous plants is that most can be safely grazed during certain times of the year. Ranchers used to control larkspur on rangelands and pastures by grazing sheep before cattle. Because sheep were not poisoned by the plant, ranchers could drastically improve the chances of not poisoning cattle because the sheep had eaten the larkspur early in the spring.

Tom Whitson, Extension Service Weed Specialist at the University of Wyoming, says in his state the switch from sheep to cattle production has meant that rangeland forbs once consumed by sheep have become more abundant and will likely cause more cattle losses.

James says that's why it is becoming more important every year for ranchers to carefully manage their pastures and rangeland. Ranchers should learn to "read" plants and make judgments about their toxicity level, he says, noting that larkspur becomes less toxic, except for its pods, as the plant matures.

Livestock producers should sample tall larkspur and have it tested by the lab in order to obtain an estimate or prediction of the toxicity of leaves and flowering parts.

Toxicity from the alkaloids in the plants vary from plant to plant. Getting completely rid of them is impossible because many have the nasty but natural ability to drop seeds that can lie dormant for years before sprouting. Tall or duncecap larkspur plants often live more than 70 years after they are established.


Tall larkspurs

"That is a remarkable trait that assures survival and perpetuates the next generation," James says. "It's a characteristic known as 'persistence.' Weeds have it made."

Seeds from most weed species can "sleep" through both favorable and unfavorable conditions. The elements that allow these seeds, in a sense, to choose when to break their suspended animation have been bred out of garden and crop plants in order to get them to grow quickly and uniformly.

The lab has published a livestock producers handbook on grazing tall larkspur ranges. It provides a framework to help ranchers manage cattle consumption of the plant. It provides several detailed descriptions of the plant at its various growth stages and the likely results of ingestion.

For a copy of the handbook, or for more information, call the lab at 435-752-2941. **JT**

MORE INFO

Lynn James **(435) 752-2941**

Lynn James, Research Director of the Agricultural Research Service's Poisonous Plant Laboratory at USU, is not only doing something about the effect of toxic weeds on livestock, he's addressing their effect on his own species, specifically children.

He estimates that during the past 40 years more than 50,000 kids have come through his lab or heard his presentation on the poison in plants.

His recent talk to a group of FFA students from Weber County focused on the effect of toxins on living tissue, especially embryos. But he began with a stern bit of career counseling, and ended with some grandfatherly advice about drug use among teen-agers.

"Let me start with the most important thing I've got to tell you today," James says as he arranges his display of weed samples to camouflage for the moment his specimens of one-eyed calves and lambs.

He looks up and says, "The most important thing I've got to say is that you FFA kids are in trouble. Kids from the city are kicking the hell out of ya."

A girl and boy who have been giggling and pinching each other stop.

"They come here without a lot of nonsense. They're on the edge of their chairs. They're sharp and alert and know where they're going, and they're going to take your jobs."

He pauses a moment to let the students grasp the notion that no, he's not kidding.

"There's never been more opportunity in agriculture than right now, and we need you farm kids. We need you kids who have that first-hand connection with agriculture. That doesn't mean you'll be in production agriculture. You most likely won't be. But there's loads of opportunity out there if you'll take it."

James allows the quiet to ring in the room for a long minute. He still hasn't smiled. "Let's get to what you came for."

He lectures for a good 50 minutes on the effects of toxic plants in all their varieties. "For instance, we know that this cyclopean lamb was the result of its mother eating a poisonous plant on day 14 of gestation. If she eats it a few days earlier or a few days later, the lamb is healthy."

Gary Neuenswander

Lynn James tells gradeschoolers how too much of a good thing can be harmful.

He asks the group if vitamins are poisonous. They decline to answer, sensing they're being set up to say "no." James doesn't wait for a response. Vitamin A is a trace mineral that a human will die without, he says. "You'll also die if you have too much."

What every living thing puts into its body has an effect on the cells of that body, he sums up. "So, given what we've been talking about today, what do you think you should do if someone offers you a plant called tobacco? Or this one?" He holds up a plastic-encased sprig of marijuana.

"They call the effects of these plants various things, but the main thing they do is intoxicate," he says. "These animals we've been talking about become intoxicated on plants, some can become habitual eaters of certain plants. Some become intoxicated to the point of death. Just like people. The effect in us can be from getting high to being dead. Think about that once or twice today, OK? Any questions?"

When none surface, James thanks the group for coming.

After they've cleared out, he says again he's probably given the talk to more than 50,000 kids in the past 40 years. But he's shaking his head slightly as he says so this time.

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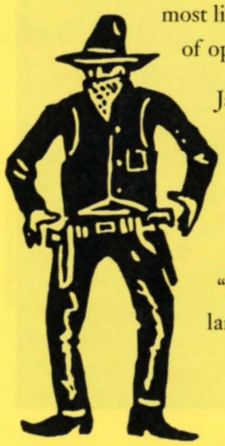

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Food "Speaks Out" in Washington

R. Dean Plowman is a farmer, a scientist, a respected former U.S. Undersecretary of Agriculture, administrator of the USDA's Agricultural Research Service and a member of the Utah Land Grant Hall of Fame.

But there's a good chance that he's best remembered as that guy who wheeled the grocery cart full of food into the halls of Congress.

"That's fine with me," Plowman said in an interview recently. "I'd do it again in a minute."

Plowman, now retired and living in North Logan, isn't easily given to ruckus. But he raised one that day in 1995 with the visual aid he decided to use to bolster his oral testimony before a congressional appropriations committee.

"It wasn't a PR stunt. I was trying to make a point," Plowman said. "Everybody thinks that agricultural research dollars just go to farmers to pay them not to farm. I stopped at my local Safeway and got 50 or so items and simply showed the committee how every item was a direct result of, or directly linked to, funding for agricultural research."

As an undersecretary, Plowman had the duty of defending budget requests for agricultural research.

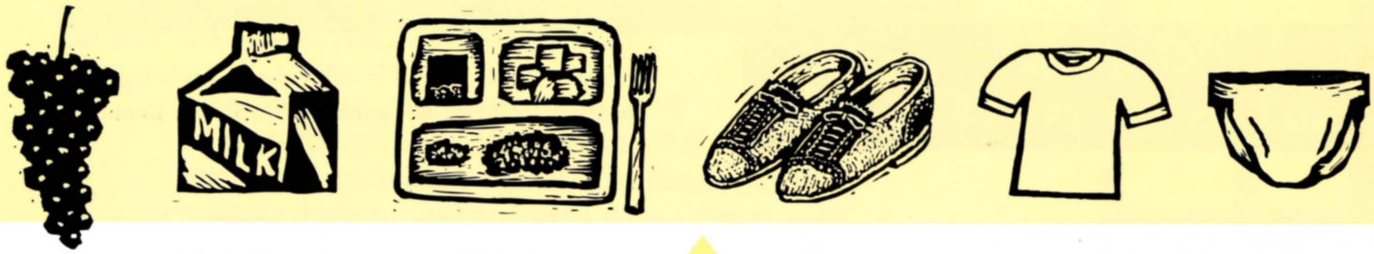
"The longer I was in Washington the more I realized people don't have an inkling of what agricultural research has done for them," Plowman said. "Or if they did, they've forgotten. Maybe we (USDA) are our own worst enemy because we've helped farmers produce food so abundantly that people just take filled grocery stores for granted."

The most important thing Americans should remember, Plowman said, is that they pay less for food than citizens in any other nation yet have it in more abundance than anyone in the history of the world.

His office published a brochure to help remind the public. On the inside cover it states: "Each year, dozens of improved products and new varieties of

Gary Neuenswander

R. Dean Plowman, former U.S. Undersecretary of Agriculture and administrator of the USDA's Agricultural Research Service, remembers wheeling a shopping cart in front of a congressional appropriations committee in 1995.



fruits, nuts, and vegetables emerge from the laboratories and greenhouses of the Agricultural Research Service. Next time you find yourself behind a shopping cart, take a look. You'll find that there's plenty of scientific know-how on your supermarket shelves."

Among the products Plowman displayed that day in Congress were seedless grapes, lactose-free milk, frozen orange juice, a dozen ways soybeans are used, frozen fruit, frozen vegetables and dinners, clothes, shoes and even disposable diapers.

"One of the committee members said, 'Surely you're not going to say there's food in diapers,'" Plowman said. "I told him no, but that it's a food product. The substance that makes disposable diapers so absorbent is a hybrid of cornstarch and a synthetic chemical."

SuperSlurper, as it is called, can absorb 2,000 times its own weight in water. It is also used in fuel filters, baby powders and wound dressings.

Plowman said he could have also showed the committee a poinsettia, which has had a 400 percent increase in sales the past 20 years since the Agricultural Research Service (ARS) improved its heartiness.

The ARS didn't discover penicillin, but a forerunner of the ARS figured out how to mass-produce it.

People can also thank the ARS for a mozzarella cheese—the main cheese on pizza—that is 10 percent fat but has the same melt and stretch quality of full-fat versions.

"The list goes on and on," Plowman said. "I'm ruined going into the grocery store; all I see is science on the shelves."

A person might think that as good a job as agriculture has done the industry would have a lot of power in Congress, Plowman said.

"But food producers have very little clout," he said. "A few generations ago people understood that cereal and bread were from grain from the ground and that milk was squeezed out of a cow. But now we're so far removed from the process. Maybe we've been doing so well and made everything so convenient that we've forgotten the importance of what we do. No one seems to ever forget to eat, though." **JT**

MORE INFO

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Recent Grants and Contracts

Ron Munger, Nutrition & Food Sciences Department, is investigating how nutrition affects the risk of hip fracture among Utahns. Funding is provided by the U.S. Department of Health and Human Services and the National Institutes of Health.

The Animal and Plant Health Inspection Service of the USDA is underwriting a study by **John Evans**, Plants, Soils & Biometeorology Department, to determine the distribution of goatsrue and to develop strategies for its elimination.

The availability in ruminants of microbial protein synthesis and milk protein yield is being studied by **David Vagnoni**, Animal, Dairy and Veterinary Science, for Ajinomoto Co.

Bruce Bugbee, Plant, Soils and Biometeorology Department, is using funds from NASA and Goddard space laboratory to study crop optimization and failure using carbon-dioxide gas-exchange.

Fred Provenza, Rangeland Resources Department, received USDA underwriting for a short course on the interaction between herbivores and plants.

Development of possibilities for value-added options and alternative agricultural enterprises in Juab County are being investigated with county government funds by **DeeVon Bailey**.

Diane Alston is trapping and transplanting *anthophora terminalis*, a pollinator of the rare orchid, *spiranthes diluvialis*. Funding is from the BLM.

The effect of saline wastewater from a power plant near Hunter, Utah, on soil, irrigation water and crop yields is being studied by **Lynn Dudley**, Plant, Soils & Biometeorology Department with funding from PacifiCorp.

The effectiveness of a water conservation policy at the Granite School District in Salt Lake City is being analyzed by **Roger Kjelgren**, Plants, Soils & Biometeorology Department.

Tilak Dhiman, Animal, Dairy & Veterinary Sciences, is studying the health effects of conjugated linolenic acid. His funding is from the National Beef Council.

The Utah Community and Economic Development Commission awarded funding to **Kenneth White**, Animal, Dairy & Veterinary Sciences, for the Center for Developmental and Molecular Biology.

Robert Hill, Biological and Irrigation Engineering Department, is using funding from the Utah Department of Agriculture to compare drip, surge and furrow irrigation on onion production.

Various pharmaceutical companies have asked **Kenneth Olson**, Animal, Dairy & Veterinary Sciences, to study the efficacy of feed products development for supplementing grazing livestock.

John Morrey, Animal, Dairy & Veterinary Sciences, is looking into ways to improve the marketability of milk with funding from the Utah Department of Agriculture.

Randall Wiedmeier has Utah Department of Agriculture funding to investigate an accelerated cow/calf production system that is less reliant on public lands.


Wheat Fit for an Astronaut

They're not exactly "amber waves of grain." But the plants Bruce Bugbee of Utah State University has arrayed in computer-controlled growth chambers represent a new, short variety of wheat he and his colleagues bred to grow in space. Its name, Apogee, comes from the point in orbit farthest from earth.

"In space, volume is a precious resource," says Bugbee. "The shorter the plant, the closer you can put the shelves where it will be grown." Good food matters: If space travelers don't like their food, little woes could become big. And on flights to distant planets they'll have to grow and prepare their own food.

Bugbee began with Superdwarf, a poor-yielding eight-inch-high variety. After 12 years of crossbreeding, he reached Apogee, which grows to 18 inches, yields the equivalent of 150 bushels an acre under normal light, nearly 1,000 under constant high light. What's more, Bugbee claims, it makes good bread." Superdwarf was grown last year on the Russian space station Mir, producing flowers but no seeds. Apogee should get a space tryout soon.

NATIONAL GEOGRAPHIC, NOVEMBER 1997

USU Plants, Soils, and Biometeorology Professor Bruce Bugbee's on-going research to breed wheat that will grow in space is highlighted in the November 1997 issue of *National Geographic* magazine.

A short article and a photo of Bugbee in his lab appear in the Geographica section of the publication.

HELP FOR PRIVATE FOREST LANDOWNERS

An education program designed to help private forest landowners in Utah make informed decisions about the management of their lands and resources is under way.

Utah State University Extension received $102,200 from the state Legislature for fiscal year 1997-98 to develop and conduct the program, which is being coordinated with the state Division of Forestry, Fire, and State Lands and the Utah Farm Bureau.

The legislation that established the program was sponsored by Sen. Alarik Myrin, chairman of the Senate's Natural Resources Committee. The bill embodied a special forest practices task force recommendation that "a comprehensive, focused education effort" is needed "in order to reach landowners at critical points in the process of considering or planning a (timber) harvesting operation."

Sen. Myrin says that the goal of the bill is not to regulate but to educate private forest landowners who have little forestry expertise.

"The goal I have and that should be carried forward with this program in dealing with this issue is that landowners need to have the information available to enable them to harvest timber using good science and stewardship," he says. "Keep in mind that timber is a renewable resource, and with proper harvesting the soil and timber resource cannot only be maintained but improved."

Continued on next page

He says another part of the education program should be to work with Extension and others in local and state economic development programs to build local industries that use forest products so that the value-added factors stay here instead of going out of state.

"We felt there was a need to deal with the issue one way or another," Sen. Myrin says. "We're going forward with education and good science to back it up."

Lisa Dennis-Perez, a recent graduate with a master's degree in watershed science and forest policy from USU, was hired in August as the Extension Forestry Program Associate. She worked with the Utah Forest Practices Task Force and visited several private timber sites in 1996.

Dennis-Perez is working with Extension Forestry Specialist and USU Forest Resources professor Michael Kuhns. They are developing educational materials relating to timber sale contract provisions, harvesting practices, forest health, management of wildlife, recreation, grazing, water quality and forest regeneration.

Kuhns says that an important component of the landowner education program will be development and maintenance of an accurate database of forest owner names and addresses. That will allow timely dissemination of workshop announcements, newsletters and other educational materials.

To find out more about the education program, or to be included on the program mailing list, contact Dennis-Perez at 435-797-0560 or by e-mail at lisadp@ext.usu.edu. **JT**

EXPERIMENT STATION ADVISORY COMMITTEE FORMED

Ways the Experiment Station might better educate Utahns about the vital role agriculture plays in the state was one of several priority issues a new UAES Advisory Committee plans to address in the coming years.

The committee, which met for the first time in a day-long session Sept. 5 at USU, is comprised of 16 leaders in agriculture from across the state who not only have an interest in, but a stake in, the future of the UAES.

Nearly every member of the committee voiced a concern about lack of public awareness of the vital role agriculture plays in their daily lives.

Robert Adams, General Manager of Circle Four Farms in Beaver County, said he believes the industry faces a two-pronged problem: food is inexpensive and therefore taken for granted; there are fewer and fewer people working in agriculture.

Committee member Dean Blackhurst of Utah County and a member of the Utah Dairy Commission said he is worried that not enough people understand the effect of having farmlands displaced by urban development.

The UAES has always had an advisory committee on campus, but this is the first committee formed exclusively of stakeholders, said UAES Director Dr. Paul Rasmussen. "This new committee gives us another avenue for accountability as well as a source of input from people closest to the issues in Utah agriculture."

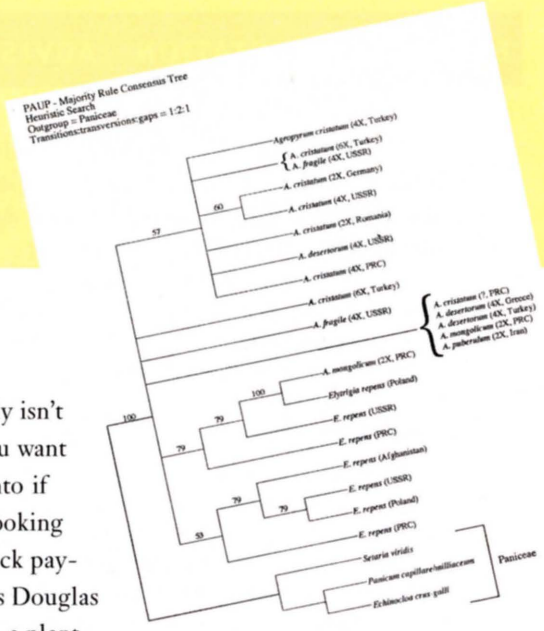
Agricultural commodities represented by committee members are swine, vegetables, dairy, water, meat processing, pastures, mink, soil, wildlife, sheep and grains. Utah families are also represented.

The committee members are:

Rob Adams, Beaver County
Carol Bench, Governor's Office
Charles Black, Davis County
Dean Blackhurst, Utah County
Marcus Blood, Hill Air Force Base
Clyde Bunker, Millard County
Craig Buttars, Utah legislator, Cache County
Gary Crowley, San Juan County
Rick Danvir, Rich County
James Draper, Sanpete/Salt Lake County
Dean Hansen, Sanpete County
Mike Judd, Box Elder County
Lee Pettit, Salt Lake County
Ellis Roberts, Cache Valley
Kent Vernon, Summit County
Gordon Younker, Cache County

The committee chose Adams to be its chairman and Danvir as its co-chairman. The two, along with Bench, Younker and Black, were named as an executive committee. **JT**

Speeding up Natural Selection



Lilies and other crops might be known for not having to toil much in their fields, but for grasses in the rangelands of the West, survival is a constant battle.

It's tough to get a foothold let alone thrive in the alkaline, near-desert conditions for the plants that provide feed for livestock and keep the region's topsoil from blowing or washing away.

But the grasses have science on their side. The main ally is the Forage and Range Research Laboratory of the USDA's Agricultural Research Service (ARS). The unit works in cooperation with the Utah Agricultural Experiment Station from a laboratory on the USU campus just north of the Fine Arts Center.

The nine full-time scientists along with several visiting scientists and a nine-member support staff are doing their best to green the West and other arid and near-arid lands around the world.

The unit's mission is to broaden the genetic base of rangeland and pasture plants, as well as provide an array of improved native and introduced grasses, legumes and forbs that will upgrade private and public lands in the western United States.

It is a slow, detail-oriented, vital process that probably wouldn't get done if the ARS didn't do it. As a rule, private companies can't afford the financial input it takes to keep coming up with the world's next best variety of arid grasses. Developing a new strain and bringing it to market or "release" takes 10 to 12 years.

"This obviously isn't work you want to get into if you're looking for a quick payoff," says Douglas Johnson, a plant physiologist whose main job is to identify the stresses on plants caused by wildfire, livestock, nematodes and plant competitors.

Using the world's largest living museum of grasses gathered from around the world, the scientists develop varieties that meet the specific needs of conservation, restoration and reclamation projects.

They search out or breed for tolerance to environmental stresses such as drought, excess salinity and cold temperatures. They also develop improved grasses and legumes that make the wilds more hospitable for human habitat and more desirable for animal production.

Since 1970 the lab has released 15 varieties of wheat grasses, four new forms of alfalfa, a clover and a wild rye. Tom Jones, a research geneticist, heads a research project on native plant improvement that has resulted in the release of Indian ricegrass and bottlebrush squirreltail germplasms. Researchers will release a wheatgrass this fall for use in revegetating roadsides.

The scientists are developing other low-maintenance, drought-resistant turf grass to be used for soil conservation along roadsides and similar areas.

Gary Neuenswander

Left: ARS scientists, Kevin Jensen, Douglas Johnson and Kay Asay check test plots. Right: Jerry Chatterton in the on-campus greenhouse.

Gary Neuenswander

"Our job is to be aware of what the public is concerned about and do what we can to make sure those concerns don't develop into full-blown problems," says Kay Asay, a plant geneticist who has been at the lab since 1974. "We take that job seriously because nowhere else in the country is this kind of work being done with these forage species."

Johnson says rangeland practices are coming under a lot of public scrutiny, and grazing permits are being limited. "So farmers and ranchers are looking for alternatives. In addition, the public is concerned about reclamation and recreational uses and green spaces. Everybody's concerned about what the future holds."

"A lot of people don't realize that after every range or grassland fire, thousands of pounds of seeds are replanted," says Jerry Chatterton, director of the ARS lab. "Grass varieties we develop are used to help those lands heal."

Several varieties of grasses are being grown by Gunnison grass seed farmer Charles Inouye. Inouye, who will harvest several varieties this year, planted about 15 acres in Vavilov, a grass the lab released in 1995 that is very drought resistant, particularly on sandy soils.

"Vavilov seed is new and in very short supply, but demand is already quite high," Inouye says, noting that the BLM is an interested buyer. Hill Air Force Base is also testing the grass on some of its rangelands in Utah's west desert.

"There's a lot we don't know , but there is a lot of promise in this variety," Inouye says.

Generally the lab does not receive royalties from the new plant materials it releases. Revenues from the small fee charged by the Utah Crop Improvement Association to farmers who grow foundation seed are used to help fund additional research.

"Our goal is to speed up natural selection," says Kevin Jensen, a plant geneticist with ARS. "We identify specific characteristics, in some instances actual genes, that are important and increase the gene frequency to effect plant improvements. When we're done we like to think we've made some plants and the world a little better."

"With the advent of biotechnology, we can do our jobs better and faster," says Richard Wang, a plant geneticist with the ARS lab. He and Margaret Redinbaugh, a plant physiologist in the lab, are identifying genes and molecular markers that can be used to speed up the breeding processes involved in developing improved forage plants. **JT**

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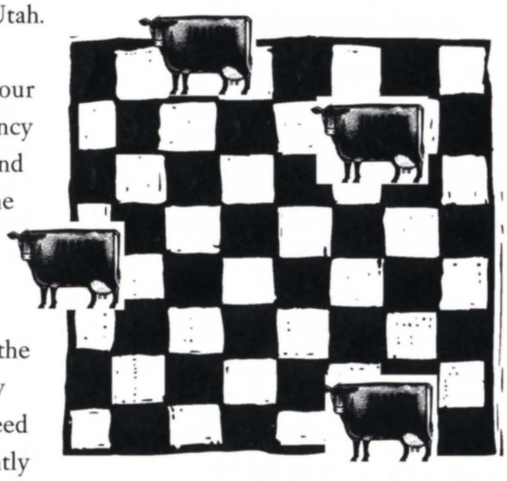
SOMETHING TO CHEW ON

Ellis Roberts is standing on the southeast corner of his farm and has just been introduced as the Dean of Pasture Grazing in Cache Valley. The dairyman accepts the praise then passes it on to those gathering around him—a group of agriculture experts in front and a herd of Holsteins behind.

"My boy always loved being around the animals growing up," Roberts says. "Over the past six years, with a lot of help from some of you folks here today, we're finding ways to let cows be cows."

The visit to Roberts' dairy farm is the first of four field stops during a daylong tour in July of privately owned intense grazing operations in Northern Utah. The tour was part of the first-ever workshop arranged by the USU Pasture Committee. The tour group, which is made up of ranchers, public agency personnel, and Extension researchers from around the West and from several universities around the country, saw dairy, beef, sheep and ranchette operations in Utah, Idaho and Wyoming.



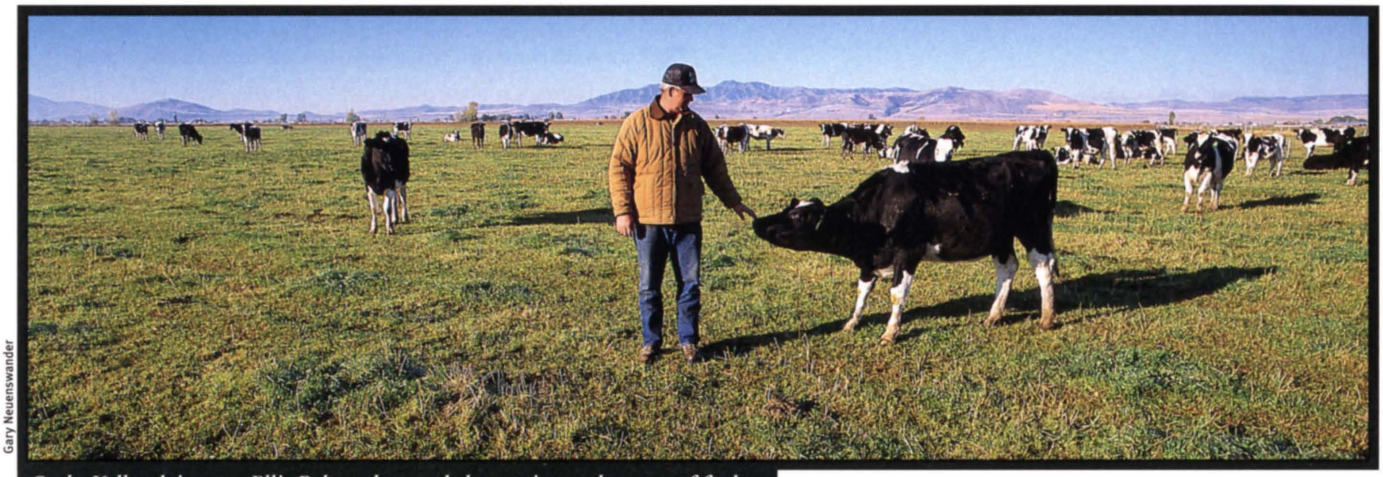
Roberts offers a long list of benefits he says are the direct result of switching his operation to mostly intensive grazing. He says his cows calve and breed easier and that the herd of about 350 head recently went 60 days without a sick pen. He says the calf loss rate is down to 14 percent from 35 percent. "The cows just seem happier, and there is no better quality feed than what you're looking at right now."

The dairyman is happier, too. Making harvesting and storage of feed a minor part of his operation has given Roberts his life back, he says. Also back is the son who loves animals. David, who has a degree in statistics from Brigham Young University, is co-operating the farm with his father and he plans on staying.

Grazing, probably the oldest known form of agriculture, is being revived by Roberts and others like him across the country in the late 20th century. A handful of farmers and beef producers in Utah are adapting it as a way to offset high costs associated with the industrial age era of producing and storing huge quantities of hay.

Under the system, farmers plant most of their former alfalfa fields in grass-legume pasture, then subdivide those fields into smaller cells where cows do their own harvesting. The cows graze each cell for about 12 to 14 hours and then are rotated into a neighboring cell. A grazed plot is allowed to regenerate growth for about a month before being grazed again.

Roberts says he can graze his herd for up to nine months. He stores the harvest from his remaining



Gary Neuenswander

Cache Valley dairyman Ellis Roberts has made harvesting and storage of feed a minor part of his operation.

alfalfa fields as well as surplus grass, and he buys about 750 tons of hay for supplemental feed during the hardest winter months.

He notes, however, that cows don't mind eating through snow cover. But the snow will regularly ice over during the winter, leaving the cows "something like a grass Popsicle" that they aren't able to eat.

"When people think of pastures, they often think of the rocky corner of a farm that's a good place to junk a car " says Ralph Whitesides, a professor and Extension specialist who coordinated the site visits. "It's often thought of as ground that can't be managed and can't be used for anything else. But what we're seeing today is evidence that counters that whole notion."

Farmers are finding they need to take a careful look at the entire operation, Whitesides says, because grazing time on public lands is being limited, and private land is being reduced by development.

VS.

"They need to find ways for getting the most of their land without grazing it to death," he says. "Sustainable grazing is a philosophy and a method that gives them an option in the foreseeable future," Whitesides says.

But he adds that many farmers are taking a wait and see attitude.

Some of Roberts' neighbors who are waiting are seeing his overall milk production go down along with the individual size of his cows. He says those are two facts that have caused some of them "to think I'm crazy" for doing this. He is quick to point out, however, that his profit margin has increased.

The traditional approach to dairying has been to achieve as much production as possible from every animal; the entire reward system in the industry—including cattle shows for the kids—is based on the amount produced or size of the animal, he says.

"Sustainable grazing is a shift out of that old paradigm," Roberts says. "When we started thinking about doing this we were heavily invested in things that don't make money. We started thinking about making money, and until a farmer starts thinking about making money instead of milk, this won't be taken seriously." **JT**

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Every Bee a Queen

The next time you're eating—even if there's not a drop of honey on your plate—take a moment to think of the tiny but able bee. Without these hardworking insects you might find a few scrawny tomatoes and berries on your plate, but there would be no tasty hybrid carrots or onions and only a paltry harvest of melons, squashes, apples, pears, plums and cherries. These all require pollination and rely primarily upon bees to do the job. Even the cows that produced the milk in your glass and the cheese in your sandwich most likely dined on alfalfa grown from seed pollinated by alfalfa leafcutter bees.

While most people tend to think all bees are either honeybees or bumble bees, there are more than 3,000 species of bees in the United States, "and more species are being found all the time," says Bill Kemp, director of the USDA's Bee Biology and Systematics Laboratory at USU.

Gary Neuenswander

The lab has more than 1.5 million bees in its specimen collection and is the site of research aimed at studying bees and discovering ways in which they can be managed as pollinators. Currently nine permanent staff members, including research scientists and technicians, work at the lab. Graduate and undergraduate students from USU also assist with the research being conducted in more than 15 research projects. The lab is one of five such facilities in the United States, but is the only one devoted to exclusively studying bee species other than honeybees.

Honeybees are familiar insects that were introduced to North America in the 1600s and introduced to millions of Americans in grade school during educational films that talked about well-organized colonies, hives, workers, drones and queen bees. What most of us weren't taught is that the majority of bees are not social insects, they don't live in hives or make honey, and that honeybees are not the most efficient pollinators.

In referring to the females among the many species of native, solitary bees, entomologist Vincent Tepedino likes to say, "Each one is a queen."

One thing we learned in school does hold true for natives such as blue orchard and alfalfa leafcutter bees: They are busy, industrious creatures.

Blue orchard bees are of particular interest at the laboratory and are gaining popularity among farmers, fruit growers and avid gardeners. The bees, which are native to Utah and other western states, are nothing less than super pollinators during their brief, adult lifetimes. Just 250 blue orchard bees can pollinate an orchard that would require 20,000 honeybees to accomplish the same task. Blue orchard bees begin working earlier in the spring, work more hours each day, are less sensitive to cold and rain, don't require special care, and are less aggressive toward humans than their distant honeybee relatives.

Researchers at the lab have found that by incubating the developing insects at specific temperatures, blue orchard bees can actually be scheduled to emerge and go to work on cue as blossoms open.

Watching blue orchard bees at work in the lab's greenhouse is a lesson in tenacity. During their adult lifetime, which lasts little more than four weeks, females spend their days making thousands of flights from their homes to sources of food, intent on gathering provisions and laying eggs that will become the next generation of bees. The bees will nest in pencil-sized tunnels drilled into blocks of wood or in bundles of paper drinking straws. They fly among blossoms gathering pollen and nectar to create a morsel about the size of a plump grain of rice. An egg is laid on each little provision of food and the chamber is sealed with mud.

Honey bees carry pollen on their legs as opposed to leafcutting bees which carry pollen by means of a scopa on the ventral side of the abdomen.

Honey bee

Leafcutting bee

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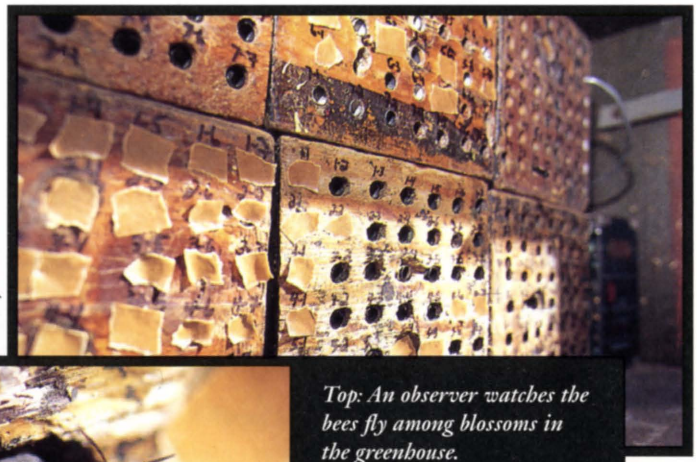

Gary Neuenswander

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Top: An observer watches the bees fly among blossoms in the greenhouse.
Above: After gathering pollen and nectar, the bees fly to nests, pencil-sized tunnels drilled into these blocks of wood.
Left: Close-up of a bee entering the nest.

Gary Neuenswander

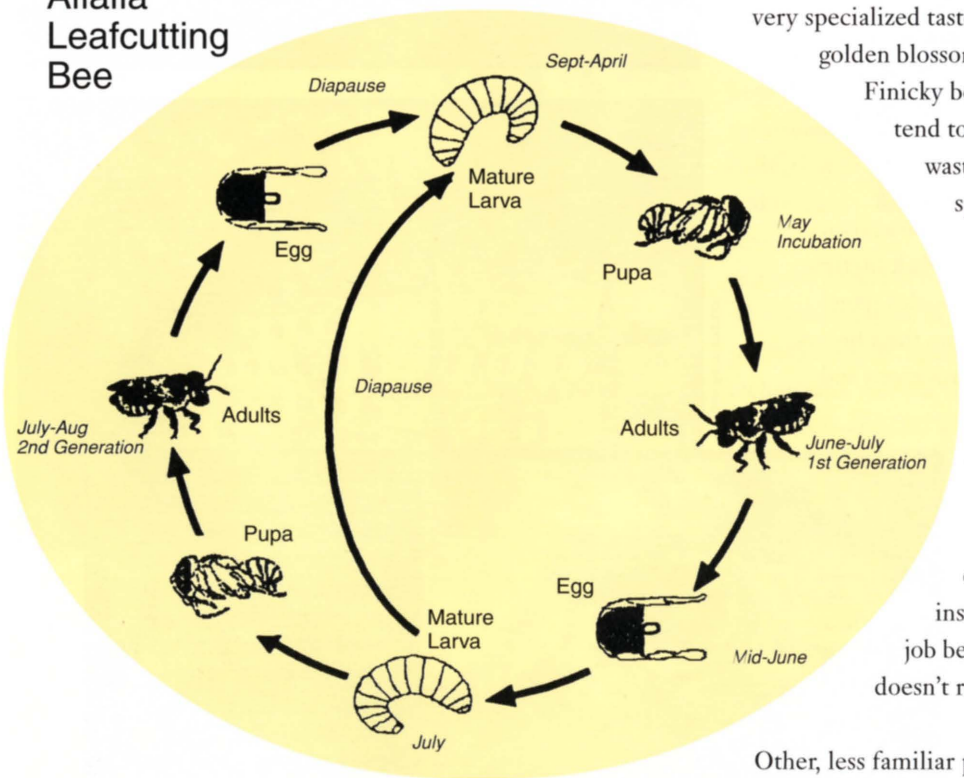
Eggs and food provisions in the nesting tube are examined by researchers.

A bee lays about six eggs in a single tunnel, with the future females deepest in the tube. Male eggs are deposited closest to the entrance. Should a predator break the mud barrier that seals the nest, the males will be eaten first.

If locations of partially filled tubes are intentionally switched by researchers while the bees are away, they won't enter an unfamiliar tube, notes entomologist Jordi Bosch. Instead, they fly back out to repeat their return trip. Upon returning, the bees eventually manage to find their own nest, probably by using scent to identify their spot. All those trips for provisions pay off handsomely in fruit later because the bees inadvertently bathe in, and scatter, pollen grains as they go.

"Pollination is a messy business," says Bosch. "Most of the work is not seen, and you don't see the effects right away. The fruit develops slowly so the impact that the bees have is separated from the reward."

Life Cycle of the Alfalfa Leafcutting Bee



Tepedino says that while some bees are not too particular about the flowers they visit for food, many solitary bees have very specialized tastes. Squash bees, for instance, dine in the golden blossoms of pumpkins, squash and gourds. Finicky bees are good for farmers because they tend to move about in a single crop rather than wastefully transporting pollen from one species of plant to another.

"Understanding bees' tastes and life cycles is an important part of the research done at the lab and in the field," says Kemp. For example, alfalfa leafcutter bees and alkali bees, which are somewhat specialized in their affinity for legumes, both appear to be useful in pollinating seed onions. Onions don't produce seed without pollination by insects. Honeybees are not the best for the job because the aromatically potent crop doesn't result in good honey.

Other, less familiar plants also rely on bees. Of 30 species of rare plants that Tepedino and colleagues have studied, most depend upon pollinators. It's a delicate balance that human

activity often disrupts. If the bees' habitat is destroyed or they are killed by pesticides, the plants will hit a reproductive wall. And because some species of bees eat pollen only from specific plants, their sole food source can be eliminated by development or herbicides.

"I fear for the existence of some species," Tepedino says. "We may not ever know the niche some of them filled. In Clark County, Nev., there are 23 species of bees that don't occur anywhere else. A few are specialized on a rare plant that only grows along the strip between Mesquite and Las Vegas, and that area is being changed more and more by people."

Why worry about saving an insect or rare plant that affects such a limited area?

"If not for the sake of preserving them simply for the niche they fill, then for their aesthetic, scientific and illustrative value. They show us some of the wonderful natural diversity around us." Tepedino says. "And many of us have a moral code or religious belief that we must husband our resources and foster their continued existence."

— Lynnette Harris
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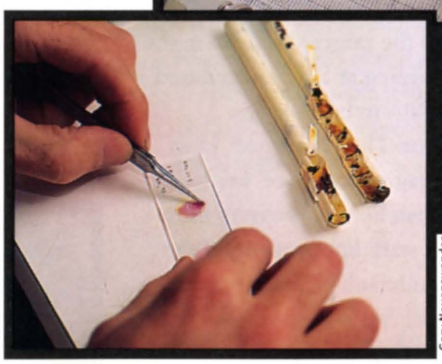

Gary Neuenswander

Bee nests are measured to get a sense of the general health of the bee population. The size of eggs and provisions will provide clues to gender and give researchers an idea of how many pollinators they will have.

In January 1997 **Bill Kemp** made a switch from more than 10 years of studying an agricultural pest—grasshoppers—to studying some of the unsung heroes of agriculture—bees. Non-apis bees to be specific, meaning all species of bees other than honeybees.

Kemp became research director of the USDA Agricultural Research Service's Bee Biology and Systematics Laboratory at USU, bringing with him 24 years of professional experience in entomology, statistical ecology and computer modeling. During his career he has developed several techniques for insect pest management and was editor of Environmental Entomology, an international scientific journal published by the Entomological Society of America.

Now his skills are being used to direct the lab's research into better understanding the dynamics of and management of non-apis bees as crop pollinators, work that is important to sustaining a sector of the agricultural industry that accounts for billions of dollars of crop production every year in the United States.

Student Spotlight

Science is the exotic realm of firing lasers, running powerful supercomputers, untangling the mysteries of DNA and conducting elegant experiments. But is also a world of attention to microscopic details, tedious observation, memorization and taking small steps from the known to the unknown.

It is in deciphering details and solving small mysteries that Rebekah Andrus has found a comfortable niche. Andrus, senior biology major, spends hours looking through microscopes examining the tiniest morphological details of bees, characteristics that help her identify and classify them. "I've gained a much greater fondness and appreciation for bees, " Andrus said. "I think when you learn more about something you will always like it more or like it less."

Fortunately for her and scientists working in the USDA/ARS Bee Biology and Systematics Lab, Andrus likes bees and the seemingly low-tech method of identifying and mounting insects even more than when she began work at the lab less than a year ago. Andrus hasn't always dreamed of being an entomologist. Her path to the insect-filled lab in the Biology and Natural Resources building at USU meandered through the University of Utah, plans to be a marine biologist and a stint as a music major. The Glenwood, Utah native came to USU as a biology major because of her growing interest in insects. During an honors program tour of the bee biology lab, she told the staff how impressed she was by their work. When a lab technician's position opened, Andrus' enthusiasm for the lab made her a memorable candidate for the job.

"Any student who is actively pursuing their educations, who puts themselves forward in new situations and doesn't just passively sit through class can find great opportunities to learn, to work and be involved in real research," Andrus said.

Active involvement in pursuing her education hasn't stopped at the bee lab. Andrus was also selected to participate in an undergraduate biology research program funded by the Howard Hughes Medical Institute. Her work in that program includes identifying more insects, but with a high tech spin. Andrus works with biologist Carol Von Dolen classifying insects by examining their genetic material.

While Andrus may be getting an educational boost from her work, the labs and their clients are beneficiaries of her active pursuit of education and her growing skills as a biologist. Bill Kemp, research leader at the USDA/ARS Bee Biology and Systematics Lab, described Andrus' abilities in terms that must be close to the highest compliment one insect lover can give another. "I think we have a real entomologist in Rebekah," he said.

"Insects are fascinating," Andrus said. "Some people think classical systematics is not as interesting as other, newer methods of identifying insects. A lot of it seems rote and just referring to books. But deciphering things and making relationships between what you know and what you see, and understanding how those insects interact with their habitat is very creative and interesting."

One of the projects Andrus is involved with at the lab is identifying bees collected at Pinnacles National Monument in California. Thus far, scientists working on the project have identified 315 species of bees in the monument's 25 square miles. Despite a mandate that land managers survey the plants and wildlife in their charge, invertebrates are usually the last to be studied. But in their role as pollinators, bees are important in determining what types of vegetation will thrive in the area.

"It's a great feeling when things click. It's fun when you feel solid about identifying some characteristics and then you can move on," Andrus said. "You won't get that in a lecture. In biology you memorize a lot, but it's like calculus; it's when you do real problems that it all makes sense."

— Lynnette Harris
UAES Information Office

Rebekah Andrus

Gary Neuenswander

Editor's Footnote

When my former boss's boss found out I had been named editor of this magazine, he said, "Well, that's great. You've always been kind of a farmer in a tweed coat."

I'm not sure how the comment was intended, but I took it as a correct assessment and as a compliment. I was raised on a farm but I have been amongst the wool set (academics) for a dozen years. Although I've never owned elbow patches, higher education and I have been kind of stuck on each other ever since we met at USU. Teachers Ann Marie Jensen, Moyle Rice and Lynn Eliason, Mike Toney and J. R. Allred made the initial introductions.

After graduating in 1979, I wrote about higher education and science as a newspaper reporter in Utah and Oregon. About five years ago, I jumped to the other end of the information pipeline when I became a news writer at the University of Utah. I don't mean to sound trite, but that job was a real education. (More on that another time.)

The family farm that raised me is no more. It lies under the slab of freeway that completed Interstate 70 and connected, via concrete, little ol' Vermillion with places like Denver and Kansas City. Dust devils kicked up in the wake of passing cars have replaced the alfalfa dust that used to plume behind our old International hay baler and settled on my neck as itchy as any tweed.

My folks were horse traders on the side. My father loved quarter horses and my grandpa was said to have had several excellent pulling teams over the years. Both men lamented the arrival of the tractor. My dad often said a tractor lets a guy get a lot more done but pretty soon he feels like he has to get a lot more done. With horses, he said, you never felt like you were wasting time if you said "Whoa" and stopped to talk to a neighbor for a few minutes. I'll bet he was right, and I'll bet every time at the parting someone would say, "You don't have to rush off do you?"

My father and his father and the first pioneers who settled that town, which was affectionately called Neversweat because that's what people claimed its residents always did, were closer to the earth. They were more vulnerable to nature's whims than we pretend to be. Careless provisioning in the fall was paid for dearly in winter. Nature exacted an honesty of effort whose absence could not be excused the way we of the Grocery Store Age do today.

My most recent professional incarnation was as the science writer at the U. I recently sent an e-mail to a friend at the University of Portland telling him that the science writing at USU has a refreshing, tangible quality to it. To highlight what I meant I retold a conversation I'd had with one of the deans at the U. who was also leaving. I asked him:

"So, what will you be doing exactly at Princeton next year?"

"You know," he replied, pausing to examine a Black Velvet No.1 pencil as if it were a fine cigar, "I really can't explain it to you; you'd have to take about 40 hours of upper division math before I could begin."

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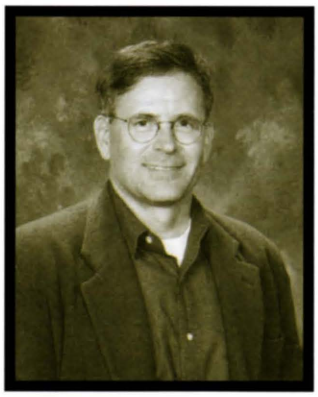

James Thalman, Editor, Utah Agricultural Experiment Station

"And you wonder why I want to go to USU."

We laughed.

Being back in Logan—i.e. closer to the earth—seems to suit me. Nevertheless, I am somewhat daunted by being the newest link in a chain of editors in a department that predates the founding of the university. This magazine also predates the newspapers and magazines where I worked before coming here.

As I hook into that long, distinguished tradition, I wish I could say I have been orienting myself toward this job my whole career. I haven't, at least not consciously. I didn't even know the position existed until this past spring when by sheer serendipity I was told it was vacant.

With help of a lot of good folks here at the station and on the faculty, I'm finding out what I've been missing—everything from clueing in on the difference between the Extension Service and the Experiment Station to understanding the indispensable work it does. Please consider this a written invitation to join me.

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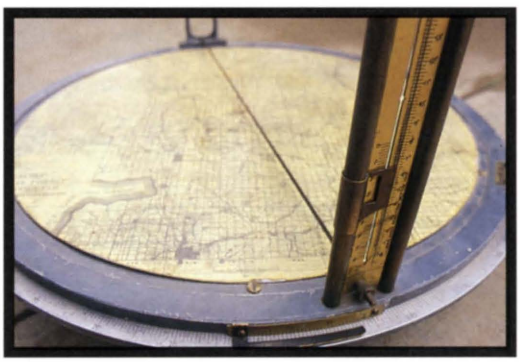
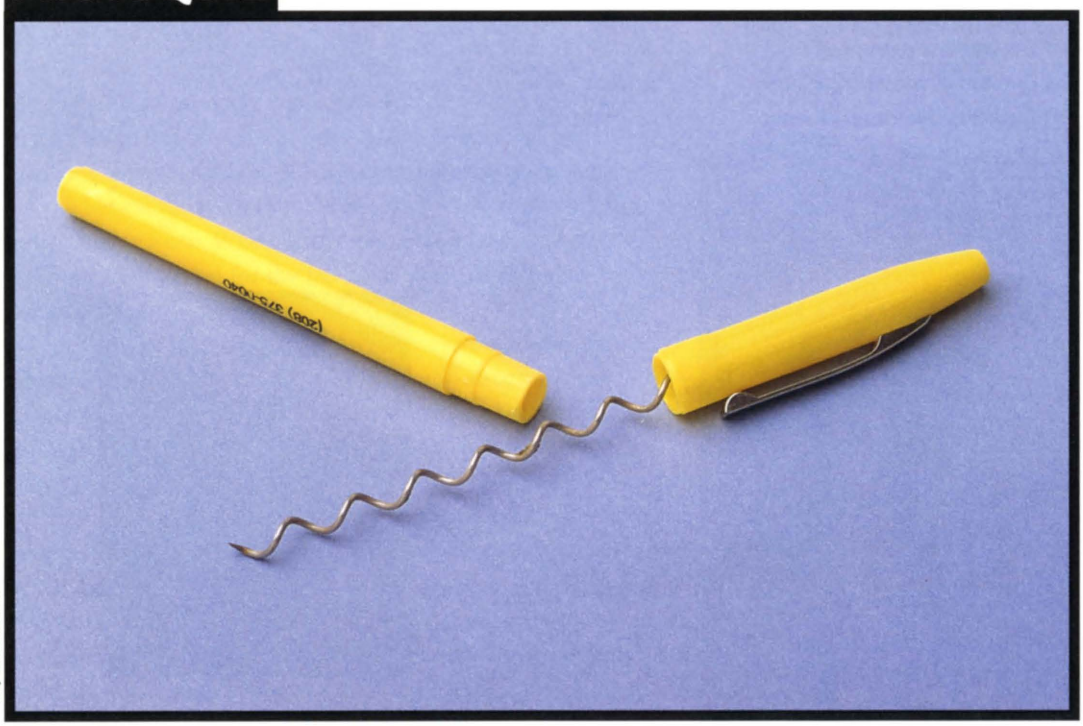


Above--
Answer to last issue's photoquiz: Osborne Fire Finder, found in fire lookouts and used to sight and map forest fires.

PHOTOQUIZ



Gary Neuenswander

Clue: Gadget used by commercial bee keepers. Answer in next issue.

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Featured Researchers

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Bill Kemp

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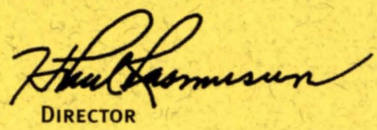

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